

ON *BURTOA NILOTICA* (PFEIFFER) AND ITS RELATIONSHIP TO *ACHATINA*, ETC.

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PLATE XVII.

IN the early part of last March Mr. E. A. Smith kindly offered me the opportunity, which I was pleased to be able to accept, of examining the anatomy of the above animal, which is, as far as he or I can learn, unknown.

The specimens, three in number, came from Bumako Island, situated in the northern part of the Victoria Nyanza, west of Entebbe, which is on the north coast. They were preserved in alcohol, in very good condition, but unfortunately two of them, owing to the quantity of eggs they contained, could not be extracted entire. The third one, received later, was fortunately extracted by Mr. Smith almost entire, and contained no eggs. The general anatomy bears a very strong resemblance to that of *Achatina*, but it seems very possible that the functional condition of the organs must have some effect on their apparent shape and position to a greater or lesser extent. Too much attention should not be paid to the shape of such parts as the spermatheca, oviduct, etc., for comparative purposes, unless one has the supposed different genera and species in more or less identical functional condition.

Externally, the visible soft parts of *Burtoa*, in the contracted condition as I had them, are similar to *Achatina*. The animal contracts in the same manner, the foot being folded together longitudinally. The top of the foot is distinctly flattened by the weight of the shell, more so than in the specimens of *Achatina* which I have had the opportunity of examining, viz. *Kraussi*.

This flattening varies considerably in the three specimens above mentioned. In one case it is particularly noticeable for a distance of 21 mm. from the hinder edge of the collar, the surface rugosities being very much obliterated; but whether this area is specialized to the same extent as has been noticed in *Archachatina*, mentioned by Pilsbry (Man. Conch., vol. xvii, p. xii), I am unable to state, not having had the opportunity of examining any of the species belonging to this group.

The lung (Fig. 1), as in *Achatina*, is short, very richly veined on both sides of the pulmonary vein (Fig. 1, *P.V.*), which has no large branches. This veining varies very considerably in different animals, as is apparent from the three I examined. The kidney (Fig. 1, *Ne.*) is a long tongue-shaped organ, having its anterior end rounded, and being twice the length of the pericardium.

The ureter (Fig. 1, *Ur.*, *U.1*) takes the usual course as in *Achatina*, and is closed throughout practically its whole length; but in the cloaca, at the point where the rectum opens into it, there is a large delta-shaped muscular fold on its upper side (Fig. 1 A, *M.F.*), which must direct the discharge from the kidney, on leaving the ureter, more or less into the grooves (Fig. 1 A, *F.1*, *F.11*) formed by it and the walls of the chambers.

The interior, quite of the last portion of the rectum, is provided with several longitudinal folds which appear to project from the inner surface of the lining at this point (Fig. 1 A, *R.F.*).

The genital system is simple, without accessory organs, and similar to *Achatina*, but the penis (Fig. 2 A, *P.*) is provided with a true retractor (Fig. 2, *R.M.*), terminal, and inserted distally on the diaphragm. The penis is enclosed in a glossy muscular sheath, and when freed is seen to be rather a slender organ. The vas deferens (Fig. 2, *V.D.*) enters through the wall of the sheath, having attached to it a strong muscular band (Fig. 2 B, *M.B.*), the other end of which is fixed to the base of the penis. This muscular band appears to be, though contained by the sheath, practically free from it, as far as attachments are concerned. The penis is directed to the left, the terminal retractor passing over the buccal mass just in front of the points of entry of the ducts of the salivary glands, its distal end being inserted on the very front edge of the floor of the lung-chamber, close to its junction with the mantle, at a point about in line with the left tentacle, thus conforming to *Limicolaria Vanatæ* and *Cochlitoma Crawfordi*, in the terminal penis retractor being inserted on the lung-floor, and mentioned by Pilsbry (Man. Conch., vol. xvii, p. viii), though no mention is made of the position of insertion in the area of the floor. After leaving the muscular sheath enveloping the penis, the vas deferens is free till it joins the prostate gland (Fig. 2 C, *Pr.*) at the base of the uterus (Fig. 2 C, *Ut.*). The male portion of the generative canal runs as a separate tube, enveloped by the membrane of the uterus.

The vagina (Fig. 2 C, *Vg.*) is short and stout, 10–15 mm. in length in the different specimens examined, somewhat swollen at the point of insertion of the spermatheca-duct, which is about 15 mm. in length. The spermatheca itself varied very considerably in shape in the specimens containing eggs, compared with the specimen that did not. In the former case it appeared as a more or less roughly triangular, or pear-shaped, somewhat flattened sac, with the duct inserted at one side, some distance from the base (Fig. 2 C, *Sp.*), whereas, in the non-pregnant or but recently pregnant animal, this organ might be called almost fusiform, the duct, it is true, being inserted a little to the side (Fig. 2 D), the only sign of a possible capability for swelling at the base being seen in some slight corrugations on the lower part just above the point of insertion of the duct. The organ was about the same length as its duct, viz. 15 mm. The free oviduct (Fig. 2 C, *F.Od.*) is about the same length as the duct of the spermatheca. The oviduct proper is of the usual form in the specimen in which no eggs were contained; in the other two cases it was much distended, with almost transparent walls. The eggs, all of which were contained in a calcareous shell, varied in size from 4 mm. in length and 2.75 mm. in breadth to 8.5 mm. in length and 6.5 mm. in breadth. There were no free embryos. From the two specimens I counted 154 eggs. The albuminiparous gland (Fig. 2 A, *A.Gl.*) is very similar to that usually found among most of the groups of pulmonates, as far as I know. The duct of the ovotestis, which is

provided with a cæcum (Fig. 2 A, *Ce.*) close to its junction with the albuminiparous gland, has the common folding, the ovotestis itself (Fig. 2 A, *Ot.*) being made up of six or more lobes of varying sizes, and more or less free from one another, and distinct. This gland is easily visible on account of its dark purple-black colour. Both the gland and its duct are enveloped in connective tissue, quite free from the liver, and in consequence there is no difficulty in their isolation.

But little could be made of the embryos contained in the shells, many of the largest of which I examined in the hope of finding some in a fairly advanced state, but in each case the podocyst enveloped practically the whole. In the more advanced specimens the first coils, amounting to from a turn to a turn and a half, were distinct, owing to their being covered with a very thin, pale-green chitinous shell, situated at the apex. In some other cases the first coils were devoid of visible covering, though well formed and situated some distance below the apex, and protruding through the enveloping podocyst. Just under the shell, and exterior to it, are two papillæ which may be the rudiments of tentacles. Under these, again, is a distinct transverse slit, a possible oral opening. The action of the spirit had caused the embryos to become quite opaque and very brittle, thus adding to the difficulty of examination.

Jaw (Fig. 3 A) more compressed laterally and not so arcuate as in *Achatina*, with three or four coarse ribs in the centre, more or less finely striated vertically over the rest of the surface.

Radula (Fig. 3 B) having about 62-1-62 teeth in a row in the widest part. Centrals narrow (Fig. 3 C), without cusps; laterals 1-34 (Figs. 3 C and D) on each side, tricuspid, at first distinctly, the entocone gradually becoming reduced till the 34th tooth is reached, after which it ceases to exist as a cusp in most rows, but in some it disappears somewhat earlier. The last 25 teeth in the row degenerate very rapidly, both the mesocone and ectocone becoming smaller and smaller till the margins are reached. The mesocones overlap the bases of the teeth in front of them, but this does not apply to about the 25 outermost teeth on each side.

Remarks.—Without taking into account the shell characters, the anatomy of *Burtoa Nilotica* shows its undoubted alliance with the Achatininae, as might be expected from its geographical range. It agrees with *Archachatina*, *Cochlitoma*, *Achatina*, *Limicolaria*, and *Atopocochlis* in the median teeth of the radula being narrow, and with *Cochlitoma*, *Achatina*, and *Atopocochlis* in the laterals being more or less tricuspid, though in *Cochlitoma Crawfordi*, examined by H. A. Pilsbry, the inner pair of laterals had entocones without well-developed cutting-points.

The jaw seems to vary too much in all the genera that have been examined to form much basis for classification at the present time.

The most important peculiarity is, without doubt, the point of insertion of the penis retractor. *Limicolaria* is nearest in agreement in this, but I have not been able to find the actual place of insertion in the lung-floor mentioned in any of the works consulted. In *Cochlitoma Crawfordi* Pilsbry found the penis retractor attached

distally to the diaphragm near its right border. In all the other Achatininae examined the penis retractor seems to be a branch of the right ocular retractor.

The following genera, *Pseudachatina*, *Columna*, *Metachatina*, and *Perideriopsis*, are, according to Pilsbry, still unknown anatomically, as is also *Callistopepla*, with the exception of the radula, which was worked out by Adolf d'Ailly (Moll. terr. et d'eau douce de Kameroun). In the present state of our knowledge the genus *Burtoa*, as exemplified by *Nilotica*, seems to fit in very nicely where it is, between *Achatina* and *Limicolaria*.

In concluding, I must offer my thanks to Mr. E. A. Smith, Mr. E. R. Sykes, and Mr. R. H. Burne for kindly assistance with literature and advice.

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 H. A. Pilsbry: Manual of Conchology, vols. xvi and xvii, October 6th, 1903-June, 1905.

EXPLANATION OF PLATE XVII.

- FIG. 1.—General view of pallial organs with the pericardium laid open.
 ,, 1 A.—Cloaca and lower portions of the rectum and ureter of another specimen laid open to show their relative positions. Also the thick muscular fold and furrows leading to ureter.
 ,, 2.—General view of the genital system with the organs in their natural position. The final portion of the albuminiparous gland was missing, and is approximately shown by dotted lines. The ovotestis and its duct were missing, but the caecum is there.
 ,, 2 A.—Albuminiparous gland with the ovotestis and its duct and caecum from an unimpregnated or recently impregnated animal.
 ,, 2 B.—Penis divested of the muscular sheath, showing muscle attached to vas deferens.
 ,, 2 C.—Lower portion of the reproductive system of another impregnated animal, laid out.
 ,, 2 D.—Spermatheca from an unimpregnated or recently impregnated animal.
 ,, 3 A.—Jaw.
 ,, 3 B.—Radula.
 ,, 3 C.—Median and first lateral teeth of radula.
 ,, 3 D.—Two lateral teeth from half-way between centre and margin of radula.

<i>A.</i> Anus.	<i>P.</i> Penis.
<i>A.Gl.</i> Albuminiparous gland.	<i>Pr.</i> Prostate.
<i>Ce.</i> Caecum.	<i>P.V.</i> Pulmonary vein.
<i>F. I, F. II.</i> Grooves leaving ureter in the cloaca.	<i>Re.</i> Rectum.
<i>F.Od.</i> Free oviduct.	<i>R.F.</i> Longitudinal folds on inner surface of rectum close to the vent.
<i>H.</i> Heart.	<i>R.M.</i> Penis retractor.
<i>M.B.</i> Muscular band.	<i>Sp.</i> Spermatheca.
<i>M.F.</i> Muscular fold in cloaca.	<i>Sp.D.</i> Spermatheca duct.
<i>M.S.</i> Muscular sheath of penis.	<i>Ur., Ur. I, Ur. II.</i> Ureter.
<i>Ne.</i> Kidney.	<i>Ut.</i> Uterus.
<i>Ot.</i> Ovotestis.	<i>V.D.</i> Vas deferens.
<i>Ot.D.</i> Duct of ovotestis.	<i>Vg.</i> Vagina.